NDIDATE'S
NUMBER

or the use of the Department only)

Tests
2

Physics 30X
1966

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DEPARTMENT
EDUCATION ALBERTA

HIGH SCHOOL AND UNIVERSITY MATRICULATION
EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1966

PHYSICS 30X

Time — 3 hours.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE QUESTIONS CAREFULLY.

Total Possible Marks — 142.

Note—Mathematical tables will be supplied by the presiding examiner. Slide rules may be used.

Use the following constants where they are required:

$g = 10\ \text{m/sec}^2$

$G = 6.7 \times 10^{-11}\ \text{m}^3/\text{kg-sec}^2$

1 calorie = 4.2 joules

$1\ \text{coulomb} = 6.24 \times 10^{18}$ elem. ch.

$1\ \text{volt} = 1.6 \times 10^{-19}$ joules/elem. ch.

Mass of electron $= 9.1 \times 10^{-31}$ kg

Constant in Coulomb's law:

$$k = 9.0 \times 10^{9}\ \frac{\text{newton-m}^2}{(\text{coulomb})^2}$$

Constant for determining the magnetic field due to a current in a circular loop:

$$K = 2\pi \times 10^{-7}\ \frac{\text{newtons}}{(\text{amp})^2}$$

When diagrams are drawn to scale, the scale used should be clearly indicated.

Rough work and diagrams may be done in pencil. Finished work must be done in ink (blue or black).

DO NOT FOLD THIS BOOKLET.

Place your test booklet in the answer envelope in such a way that the **UPPER LEFT HAND CORNER OF THE BOOKLET** (Candidate's Number) shows through the **SLASHED CORNER** of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

(For the use of Sub-Examiners only)

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CURR HIST

Values

The following 20 questions are valued at 2 marks each. Place your answers in the spaces provided. Do your rough work at the bottom of the page.

2 **1.** A strip of paper is found to be 8.8 m long and 3.46 cm wide. To how many significant figures can we express its area in sq cm? ....

2 **2.** What speed is attained by a car which starts from rest and accelerates along a straight path for 4.0 sec at the rate of 2.0 m/sec/sec? ....

2 **3.** What is the order of magnitude of the number of cu mm in 10 cu km? ....

FOR ROUGH WORK

(No marks given for work in this space)

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QUAECUMQUE VERA

Values

2 **4.** What is the ground speed of an aircraft which is flying with an air speed of 200 mph directly against a 40 mph head wind? ....

2 **5.** What is the magnitude of the acceleration of a body which moves with a constant speed of 20 m/sec along a circular path 100 m in radius? ....

2 **6.** A vehicle moving along a straight road changes its speed at a uniform rate from 45 m/sec to 60 m/sec during a 1.0 min interval. Express its acceleration during the interval in m/sec/sec. ....

2 **7.** A body is accelerated at the rate of 5.0 m/sec/sec by a 2.0 newton force acting upon it. What is the mass of the body? ....

FOR ROUGH WORK

(No marks given for work in this space)

Values

2 **8.** A freely falling body fell from rest for a distance of 100 ft in a certain interval of time. How far did it fall from rest during the first half of the time interval?

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2 **9.** An empty truck requires a distance of 40 ft to slow down from 30 mph to a complete stop when a certain braking force is applied. What stopping distance would be required by a truck twice as heavy as the first one, if it is also going 30 mph and applies the same braking force?

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2 **10.** A toy train moving along a circular track at a speed of 1.0 m/sec requires a centripetal force of 1.0 newton to keep it on the track. What centripetal force will be required if the speed of the train is changed to 3.0 m/sec?

FOR ROUGH WORK
(No marks given for work in this space)

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Values

2 **11.** Pendulum A which is 10 in long makes twice as many swings per minute as pendulum B. How long is pendulum B?

2 **12.** Car A while going 30 mph is found to have the same momentum as Car B which is going 40 mph. If Car A weighs 2800 lb, what is the weight of Car B?

2 **13.** A freely falling body gained 40 joules of kinetic energy in falling a distance of 3.0 m. How much did it gain in falling 1.5 m?

2 **14.** How great is the impulse given to a 10 kg body by a 3.0 newton force which acts on it for 4.0 sec?

2 **15.** How much potential energy is gained by a 2.0 kg body as it is raised through a distance of 8.0 m in 4.0 sec near the earth's surface?

FOR ROUGH WORK

(No marks given for work in this space)

Values

2 **16.** A 4.0 ohm resistance and a 7.0 ohm resistance are in series in a circuit. If a voltmeter shows a drop of 2.0 volts across the 4.0 ohm resistance, what reading should it show when placed across the 7.0 ohm resistance?

2 **17.** How many coulombs of charge pass a point in a conductor through which a current of 0.50 amp flows for 2.0 hr?

2 **18.** How many watts of power are being used by a heating device which draws a current of 8.0 amp while a potential difference of 110 volts is maintained across it?

FOR ROUGH WORK

(No marks given for work in this space)

Values

2 **19.** A certain single circular loop of wire produces a magnetic field of 3.0 standard units at its center when a current of 1.0 amp passes around it. How many standard units of magnetic field would be produced at the center of a single loop twice as great in diameter as the one mentioned above if the current around it is 3.0 amp? ....

2 **20.** A circular loop of wire rotated in a magnetic field generates a maximum electromotive force of 0.20 volts when turned at a certain rate. If both the diameter and the rate of rotation are doubled, what will the maximum electromotive force become? ....

FOR ROUGH WORK

(No marks given for work in this space)

Values

For questions 21 to 25 show your work and state your answer in the space after each question.

21. A boy throws a ball vertically upward with a velocity of 20 m/sec. Neglecting air resistance determine each of the following:

3 (a) how high the ball will be above its starting position 3.0 sec after it is released.

3 (b) the velocity of the ball 2.5 sec after it is released.

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **22.** A boat capable of going 8.0 mph in still water heads at right angles to the current of a river which flows at 6.0 mph. If the boat travels at maximum speed, how far away from the point at which it was launched will it be in 10 min?

3 **23.** How much centripetal force is experienced by a 0.10 gm fly resting on a phonograph record rotating at the rate of 33 revolutions per minute if its position is 10 cm from the center of the record? (Take $\pi^2 = 10$)

FOR ROUGH WORK

(No marks given for work in this space)

Values

3 **24.** What is the maximum voltage induced in a circular loop 10 cm in radius as it rotates at the rate of 25 times per second in a magnetic field of 4.0×10^{-2} newtons/amp-m? (Take $\pi^2 = 10$)

FOR ROUGH WORK

(No marks for work in this space)

Values

Answer questions 25 to 36 by writing clear statements in the space provided.

2 **25.** Explain why pictures must be projected on a screen at a minimum rate of about 16 individual pictures per second before they can be made to take on the appearance of smooth, continuous motion we see in a movie.

2 **26.** What is the basic difference between the process of interpolation and that of extrapolation?

Values

27. Imagine that you are inside a large satellite established in a circular orbit around the earth. Normal atmospheric pressure is maintained inside the satellite.

2 (a) Explain why it may be difficult to tell which way the earth is if you cannot see it.

2 (b) What special difficulty would you encounter in attempting to transfer liquid from one container into another?

3 **28.** Two small rafts float side by side in still water. A boy jumps back and forth from one raft to the other several times. Describe the resulting horizontal motion of the rafts. Explain this motion in terms of basic physical laws.

Values

4 **29.** Explain the apparently steady pressure a gas exerts on a solid surface in terms of momentum change.

30. You are given a conductor-coated pith ball suspended on a long insulating fiber and a positively charged strip of insulating material.

3 (a) Tell, step by step, how you would charge the pith ball by induction so that it will remain charged after the inducing charge is taken away.

3 (b) Describe the motions of the charges and the final condition of the pith ball which results from the procedure in (a) above.

Values

2 **31.** Why can an oscilloscope respond more quickly to forces than instruments with mechanical indicators?

2 **32.** Draw a diagram to show how you could arrange three 1.0 ohm resistors to make a total resistance with a value of 1.5 ohms.

2 **33.** Tell what is meant by thermionic emission and give some indication of its usefulness.

2 **34.** What is the direction of the magnetic field produced on the east side of a long straight wire which runs perpendicular to the earth's surface and carries an electric current vertically downward?

Values

35. Electromagnetic radiation is produced by accelerating charges. How are charges accelerated in order to produce:

2 (a) X rays?

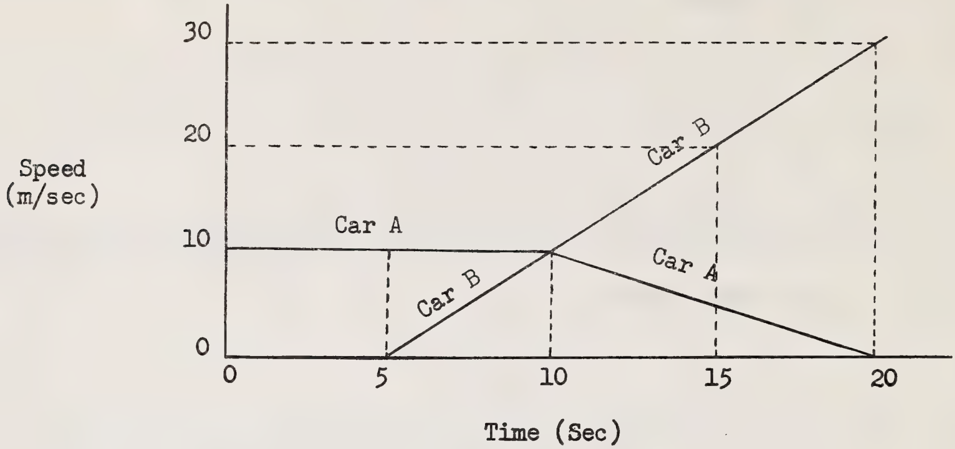
2 (b) Radio waves?

FOR ROUGH WORK

(No marks given for work in this space)

Values

36. The graphs below represent the motions of two cars, A and B. Car A travelling at 10 m/sec passes car B which is standing at rest. Five seconds later car B starts travelling in the same direction.



2 (a) How far is car A from car B just as car B starts?

2 (b) How many seconds after car B starts does it attain the same velocity as car A?

2 (c) What is the acceleration of car B 3 seconds after it starts?

2 (d) What is the speed of car B relative to car A 10 seconds after car B starts?

3 (e) How far is car A ahead of car B 10 seconds after car B starts?

Values

SHOW COMPLETE SOLUTIONS FOR THE FOLLOWING PROBLEMS. IN CASES WHERE THERE ARE SEVERAL LOGICAL STEPS TO THE SOLUTIONS INDICATE EACH STEP CLEARLY.

6 **37.** A certain coil spring is 8.0 cm long when it is not under tension. A force of 4.0 newtons stretches it so that its length becomes 16.0 cm. How much energy is stored in this spring when a 300 gm mass is suspended from it, the mass having been allowed to come to rest?

FOR ROUGH WORK

(No marks given for work in this space)

Values

38. One boy tossed a 40 gm ball vertically upward and another boy fired a 2.0 gm bullet horizontally into it just as it reached its highest point. The bullet which had a velocity of 400 m/sec lodged in the ball.

4 (a) What was the horizontal speed of the ball just after the bullet had lodged in it?

6 (b) How many calories of heat were produced by the bullet striking the ball?

Values

6 **39.** A 3.0×10^{-8} coulomb positive charge is located due north of a positive charge and due east of a negative charge of the same magnitude as itself and 10 cm from each of them. What is the magnitude and direction of the electrical force acting on the first charge?

FOR ROUGH WORK

(No marks given for work in this space)

Values

40. An electron gun shoots a stream of electrons with a velocity of 5.0×10^6 m/sec between two flat deflecting plates so that when the electrons first come between the plates they move parallel to the plates.

4 (a) What must be the potential difference used by the gun in order to make the electrons attain the stated velocity?

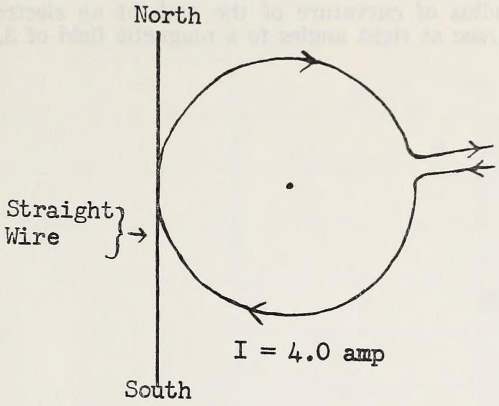
4 (b) If the deflecting plates are 1.0 cm apart and have a potential difference of 5.0 volts, how much force does the electric field between them exert on each electron?

FOR ROUGH WORK

(No marks given for work in this space)

Values

6 **41.**



As shown in the diagram, a long straight wire is tangent to a circular conducting loop which carries a current of 4.0 amp. What must be the direction and magnitude of the current in the straight wire if it is to cancel the field produced at the center of the loop by the current in the loop?

FOR ROUGH WORK

(No marks given for work in this space)

Values

6 **42.** What is the radius of curvature of the path of an electron moving with a velocity of 6.0×10^6 m/sec at right angles to a magnetic field of 3.0×10^{-3} newtons/amp-m?

FOR ROUGH WORK

(No marks given for work in this space)

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0 42. What is the [illegible] [illegible] moving with a velocity
of 6.0 × $10^{[illegible]}$ [illegible] × $10^{[illegible]}$ centimeters/sec?

[illegible]

[illegible] in this space)